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☐ ORAL PRESENTATION ☒ Abstract ☐ Full Text

TITLE	OTHER AUTHORS	
The Mars Reconnaissance Orbiter Mission Plan	M.D. Johnston, P. Xaypraseuth, C. Halsell, A. Bowes, T. You, D. Highsmith, M. Jah, D. Lyons	☐ Premeeting publication ☐ Publication on meeting day ☐ Postmeeting publication ☐ Poster session ☐ Handouts

EXPEDITE

KEY WORDS FOR INDEXING *(Separate items with commas)*
mission plan, trajectory design, MRO, mars

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LEAD JPL AUTHOR'S SIGNATURE: Robert Edward Lock — DATE: 9/11/2003

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Mars Reconnaissance Orbiter Project 3125

PERFORMING ORGANIZATION *(If different)*

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Date: Fri, 19 Sep 2003 09:41:58 -0700
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Subject: Re: Fwd: MRO Mission Plan Paper at AAS/AIAA conference
X-Sender: wblume@mailhost4.jpl.nasa.gov
To: Document Review <Document.Review@jpl.nasa.gov>
Cc: Rob Lock <Robert.E.Lock@jpl.nasa.gov>
Reply-to: William H Blume <William.H.Blume@jpl.nasa.gov>
X-Lyris-Message-Id:
<LYR65925-506187-2003.09.19-09.42.08--Marysue.Obrien#jpl.nasa.gov@list.jpl.nasa.gov>
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This abstract is approved for submission to the indicated conference.

Bill Blume

William,

Robert Lock has submitted an abstract entitled "The Mars Reconnaissance Orbiter Mission Plan" for presentation at the 2004 AAS/AIAA Space Flight Mechanics Meeting on February 9-12, 2004.

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*41141

Date: Thu, 11 Sep 2003 16:42:02 -0700
From: Robert E Lock <Robert.E.Lock@jpl.nasa.gov>
Subject: MRO Mission Plan Paper at AAS/AIAA conference

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William H. Blume Phone: (818) 354-7396
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Navigation and Mission Design Section

To: William.H.Blume@jpl.nasa.gov
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Date: Thu, 11 Sep 2003 16:42:02 -0700
From: Robert E Lock <Robert.E.Lock@jpl.nasa.gov>
Subject: MRO Mission Plan Paper at AAS/AIAA conference
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To: docrev@jpl.nasa.gov
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Also, if possible, I would like to be notified of this clearance by e-mail or voice-mail as I will be on travel from tomorrow afternoon (Friday 9/12) until next Wednesday.

Thanks in advance,

Rob Lock
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Please note: The source material for this paper is "Mars Reconnaissance Orbiter Mission Plan - CDR Version" JPL D 22239 which is already cleared for external release (CL#03-1695).


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The Mars Reconnaissance Orbiter Mission Plan

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Extended Abstract

In 2005, NASA will launch the Mars Reconnaissance Orbiter (MRO). This mission has the primary objective of placing a science orbiter into Mars orbit to perform remote sensing investigations that will characterize the surface, subsurface and atmosphere of the planet and will identify potential landing sites for future missions. A major mission of the Mars Exploration Program (MEP), MRO will pursue the Program's "Follow-the-Water" theme by conducting science observations that will return sets of globally distributed data that will be used to: 1) advance our understanding of the current Mars climate, the processes that have formed and modified the surface of the planet, and the extent to which water has played a role in surface processes; 2) identify sites of possible aqueous activity indicating environments that may have been or are conducive to biological activity; and 3) identify and characterize sites for future landed missions.

In addition to its scientific objectives, MRO will provide telecommunications relay capability for follow-on missions and will conduct telecom and navigation demonstrations in support of future MEP activities. Specifically, the MRO mission will: 1) provide navigation and data relay support services to future MEP missions, 2) demonstrate Optical Navigation techniques for high precision delivery of future landed missions, and 3) perform an operational demonstration of high data rate Ka-band telecommunications and navigation services

MRO will be launched aboard an Atlas V-401 launch vehicle from Cape Canaveral Air Force Station in Florida in August of 2005. MRO will arrive at Mars 7 months after launch and spend the next 6 months aerobraking to lower its orbit to the altitudes needed for science operations. The mission will enter a transition period wherein the MRO orbit is adjusted and the orbiter and payloads are reconfigured, calibrated and made ready for science data collection. There will be a 1 month wait while Mars and the orbiter pass through a solar conjunction when communications are too unreliable for normal mission operations. Then, in November of 2006, MRO will begin its 1 Mars year science mission. A second Mars year will be used for providing telecommunications relay services to Mars missions launched in the 2007 and 2009 launch opportunities. The primary mission will be completed by the end of December 2010. Health permitting, the orbiter will provide up to 5 additional years of telecommunications relay services to future Mars missions.

The injected mass capability of the Atlas V-401 for the MRO mission is 2180 kg. Of this, the allowable dry mass is 1031 kg; 139 kg for payloads and 892 kg for the orbiter bus. The rest of the 2180 kg is for fuel to provide the 1545 m/s delta-v needed for the mission and the majority of that (1000 m/s) is for capture at Mars. To accomplish the needed targeted observations, the orbiter is 3-axis stabilized and has large momentum wheels to provide stability and control. The orbiter design allows all science payloads to be operated at any or all times. The orbiter has an impressive telecommunications and command and data handling architecture enabling large volumes of scientific data to be returned to Earth. The expected data return for the mission is 34 Tbits.

The orbiter payload consists of six science instruments and three engineering payload elements listed as follows:

Science Instruments

- HiRISE, High Resolution Imaging Science Experiment
- CRISM, Compact Reconnaissance Imaging Spectrometer for Mars
- MCS, Mars Climate Sounder
- MARCI, Mars Color Imager
- CTX, Context Imager
- SHARAD, Shallow (Subsurface) Radar

Engineering Payloads

- Electra UHF communications and navigation package
- Optical Navigation (Camera) Experiment
- Ka Band Telecommunication Experiment

The MRO shall accomplish its science objectives by conducting an integrated program of three distinct observational modes:

- Daily global mapping and profiling
- Regional survey, and
- Globally distributed targeting

These observation modes will be intermixed and often overlapping. Some instruments have more than one observational mode. In addition, many targeted observations will involve nearly simultaneous, coordinated observations by more than one instrument.

The mission operations concept is based on parallel sequencing of the orbiter bus and the science payloads. A background sequence is sent to the orbiter every 4 weeks that manages heath and safety, telecommunications with Earth, the flow of on-board data and the basic nadir pointing of the spacecraft. The science and engineering payloads are sequenced nearly independently of the orbiter and of each other. Every 4 weeks interactive activities involving off-nadir pointing of the orbiter or multi-instrument observations are coordinated for a 4 week period. The payloads then develop independent commands for the interactive activities and for other nadir pointed observations and uplink them weekly. Off-nadir targeting relies on ephemeris driven on-board targeting algorithms that allow automatic updates to target vector and timing (within limits). Updated ephemeris files are sent to the orbiter twice per week.

This paper describes the Mars Reconnaissance Orbiter Mission Plan with emphasis on major mission activities and key challenges in mission design, spacecraft design, and science data acquisition. An overview of the mission will be provided which includes: the mission objectives, a description of the orbiter and its payloads, and the basic concept of operations. Also included will be a description of the science orbit at Mars and mission data return strategies.

Condensed Abstract

This paper describes the Mars Reconnaissance Orbiter Mission Plan with emphasis on major mission activities and key challenges in mission design, spacecraft design, and science data acquisition. An overview of the mission will be provided which includes: the mission objectives, a description of the orbiter and its payloads, and the basic concept of operations. Also included will be a description of the science orbit at Mars and mission data return strategies.

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